

## Explosives performance key to stockpile stewardship

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### Assuring the safety, security, and effectiveness of the U.S. Nuclear Deterrent

LOS ALAMOS, N.M., Nov. 3, 2014—As the U.S. Nuclear Deterrent ages, one essential factor in making sure that the weapons will continue to perform as designed is understanding the fundamental properties of the high explosives that are part of a nuclear weapons system.

"As we move forward with our stockpile and as it's aging and as we're replacing components, we want to make sure that we have confidence that those materials perform as intended," said Dana Dattelbaum, a chemist in the Laboratory's Shock and Detonation Physics group. "And that we are also continuing to improve on safety."

A new video on the [Los Alamos National Laboratory YouTube Channel](#) shows how researchers use scientific guns to induce shock waves into explosive materials to study their performance and properties.

As nuclear weapons go through life extension programs, some changes may be advantageous, particularly through the addition of what are known as "insensitive" high explosives that are much less likely to accidentally detonate than the already very safe "conventional" high explosives that are used in most weapons.

"We're very interested in understanding chemical dynamics in extreme conditions," said Dattelbaum. "Chemical reactions are occurring in very extreme environments with very fast reaction rates, and we really don't fully understand the first bond-breaking steps and the subsequent bond-breaking steps as an explosive detonates."

At Los Alamos National Laboratory explosives research includes a wide variety of both large- and small-scale experiments that include small, contained detonations, gas and powder gun firings, larger outdoor detonations, large-scale hydrodynamic tests, and at the Nevada Nuclear Security Site, underground sub-critical experiments.

At the Laboratory's large-bore two-stage gas gun scientists use highly compressed light gas, like helium, to fire a specially designed projectile into a sample of high explosive material to precisely measure and characterize the shock wave that travels through the explosive to better understand the fundamental chemical processes that lead to detonation.

In these small-scale experiments scientists are also looking at very basic materials such as ammonia and methane which are of interest in planetary physics, and simple molecules like benzene to better understand chemical reactivity at pressures that exceed those at the center of the Earth.

Ultimately, the data from both small- and large-scale experiments are used to validate and improve computer models and simulations of the highly integrated, complex systems that comprise a nuclear weapon, enhancing confidence in the U.S. Nuclear Deterrent without the need for full-scale nuclear testing.

*Caption for image below: The large-bore, two-stage gas gun at Los Alamos National Laboratory uses highly-compressed light gas to fire a projectile into a high-explosive sample to precisely measure shock waves as they travel through the material.*

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